The Ordovician–Silurian boundary in the Rocky Mountains, Arctic Islands and Hudson Platform, Canada

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Synopsis

The Ordovician–Silurian Boundary is developed within sequences of platform carbonates at Pedley Pass (southeastern British Columbia) and in the Kaskattama well (northeastern Manitoba). At Snowblind Creek (Arctic Islands), the boundary is documented within a transitional facies between platform carbonates and basinal rocks, but access to the locality is difficult and expensive. Further detailed palaeontological studies are needed to establish the precise position of the boundary at all three localities.

The Rocky Mountains

Silurian carbonates are widespread in parts of the Rocky Mountains (1400 km long, 50–140 km wide) and a graptolitic facies is locally present in the northwestern and west-central parts. Access is expensive except close to the very few roads. In the graptolitic facies (Road River Group), the Ordovician–Silurian boundary interval has not been studied in detail. Exposures are not good and unconformities are present within or below the Llandovery part of the sequence. The Ordovician *ornatus* Zone and the Silurian *cyphus* Zone are well documented (Cecile & Norford 1979; Jackson *et al.* 1965; Davies 1966) and taxa identified by Davies may indicate some of the intervening *persculptus*, *acuminatus*, *atavus* and *acinaces* Zones.

The carbonate facies consists of resistant dolomites almost throughout the Rocky Mountains. North of Peace River an unconformity is present below Silurian dolomites of the Nonda Formation. South of the Peace, the Beaverfoot Formation appears to span latest Ordovician and most of Llandovery time.

The section at Pedley Pass is typical of many in southeastern British Columbia, except that access is simple and inexpensive. The locality is within a carbonate platform, a considerable distance inboard of the platform-front. Exposure is excellent along a steep ridge above the timberline, and complete through more than 500 m of Upper Ordovician and Lower Silurian limestones and dolomites. Retreat of glaciers was relatively recent and the rocks are essentially unweathered. The terrane is folded and thrust but structure is simple within the thrust plates, with moderate dip parallel to the ridge. Disconformities have not been recognized within the boundary interval, but discontinuities could be present within the sequences of shallow water carbonates. Conodont alteration indices (CAI) of 4 are known from just above the Beaverfoot Formation near Pedley Pass (Goodarzi & Norford 1985: 1091, sample D) and thus the rocks of the boundary interval have high thermal maturity and are quite unsuitable for palaeomagnetic and many geochemical studies.

At Pedley Pass, 130 m of poorly fossiliferous dolomites separates an Upper Ordovician coral and brachiopod fauna (*Bighornia–Thaerodonta* Fauna of Ashgill age) from the lowest brachiopods (*Nondia* sp.) and corals (*Rhegmaphyllum* sp., *Streptelasma* sp.) confidently dated as Silurian (*Eostropheodonta* Zone, part of *Virgiana* fauna, upper Lower to Middle Llandovery). Macrofossils are present in the intervening rocks but are poorly preserved. Conodont studies of these beds have not been completed, but preliminary data (T. T. Uyeno *in* Norford 1969: 39) from a corresponding interval at Mount Sinclair, 25 km north of Pedley Pass, indicate that the Ordovician–Silurian Boundary lies somewhere within the upper 75 m of the poorly fossiliferous interval at Pedley Pass.

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Thus, the Beaverfoot Formation seems to show sedimentation across the Ordovician–Silurian Boundary but the problems are those of precisely locating the boundary and the high thermal maturity (CAI 4) of the rocks. The region is not suitable for a stratotype of more than local application.

The Arctic Islands

The Arctic Platform and the Inuitian Orogen comprise a vast region (2000 by 1000 km) in which Ordovician and Silurian rocks are widely distributed, both in outcrop and subsurface. Exposures are mostly good, but logistic dependency on aircraft makes access expensive and then only possible during the short summer. A carbonate shelf is bounded to the northwest by a graptolitic facies, locally stratigraphical sections show the interfingering of the two facies in great detail, for example, along Snowblind Creek, Cornwallis Island (Thorsteinsson 1959). Broad open folds characterize the structure in most of the Arctic Platform; thermal maturities are low on Cornwallis Island (Conodont Alteration Indices 1 to 2, Uyeno 1981 and *in* Goodarzi & Norford 1985: 1091, sample B). Macrofossils are not common in the carbonate facies, but the graptolitic facies is very fossiliferous, locally with exquisite preservation of graptolites in full relief within limestone nodules. Palaeontological studies of both macrofossils and microfossils are only at a reconnaissance level at present, but the region has great promise for the achievement of detailed correlations of zonal schemes based on various phyla.

Carbonates of the Allen Bay Formation, the Baillarge Formation and correlative rocks contain corals, cephalopods, brachiopods, gastropods, trilobites and receptaculitids. Ashgill faunas resemble those of northwestern Greenland and the Hudson Platform. Conodont faunas indicate Fauna 12 of the United States with the same fauna present in latest Caradoc rocks; Fauna 13 may also be present below conodont faunas indicative of the mid-continent Lower Silurian *kentuckyensis* Zone (Ryley 1984). Very early Silurian macrofaunas have not yet been collected from these formations, and, similarly, the conodont faunas are poorly known.

Most probably, all of latest Ordovician and earliest Silurian time is represented within the Cape Phillips and Ibbett Bay Formations of the graptolitic facies. However, the graptolite faunas have not yet been described taxonomically and the presence of the *pacificus*, *extraordinarius*, *persculptus* and *acuminatus* Zones have not been established. Cephalopods, radiolarians, sponge fragments, ostracodes, polychaetes and trilobites are associated with the latest Ordovician graptolite faunas and allow correlation into the carbonate facies.

Thus, the Late Ordovician and Early Silurian macrofaunas and microfaunas have yet to be described, but the intricate facies relations of carbonates and graptolitic rocks make it a region of international importance for the discrimination of the Ordovician–Silurian Boundary. The section at Snowblind Creek on Cornwallis Island is eminently suitable as a key section for intercontinental correlations except for its difficult access. The variety of fossil groups within the graptolite zones provides for detailed correlation of shelly benthic zones with the standard graptolite zonation.

The Hudson Platform

The Hudson Platform is a large remnant (1600 by 1000 km) of a sequence of Palaeozoic carbonates and evaporitic rocks that once covered much of the Canadian Shield. The platform now floors Hudson Bay, but the rocks extend onshore in the Hudson Bay and James Bay Lowlands to the south and on Southampton, Coats and Mansel Islands to the north. Access to all of these areas is difficult and costly. Outcrop is very sparse in the Lowlands and limited to the major rivers and some intertidal regions; exposures are less rare in the northern islands but stratigraphical sections are few and incomplete. The rocks are essentially flat-lying with rare faults. Thermal maturities are low. A number of wells have been drilled in the Lowlands and offshore in the central regions of Hudson Bay; these provide the best stratigraphical sections and several (including Sogepet–Aquitaine Kaskattama Province No. 1) took continuous slim core through the Ordovician–Silurian Boundary.

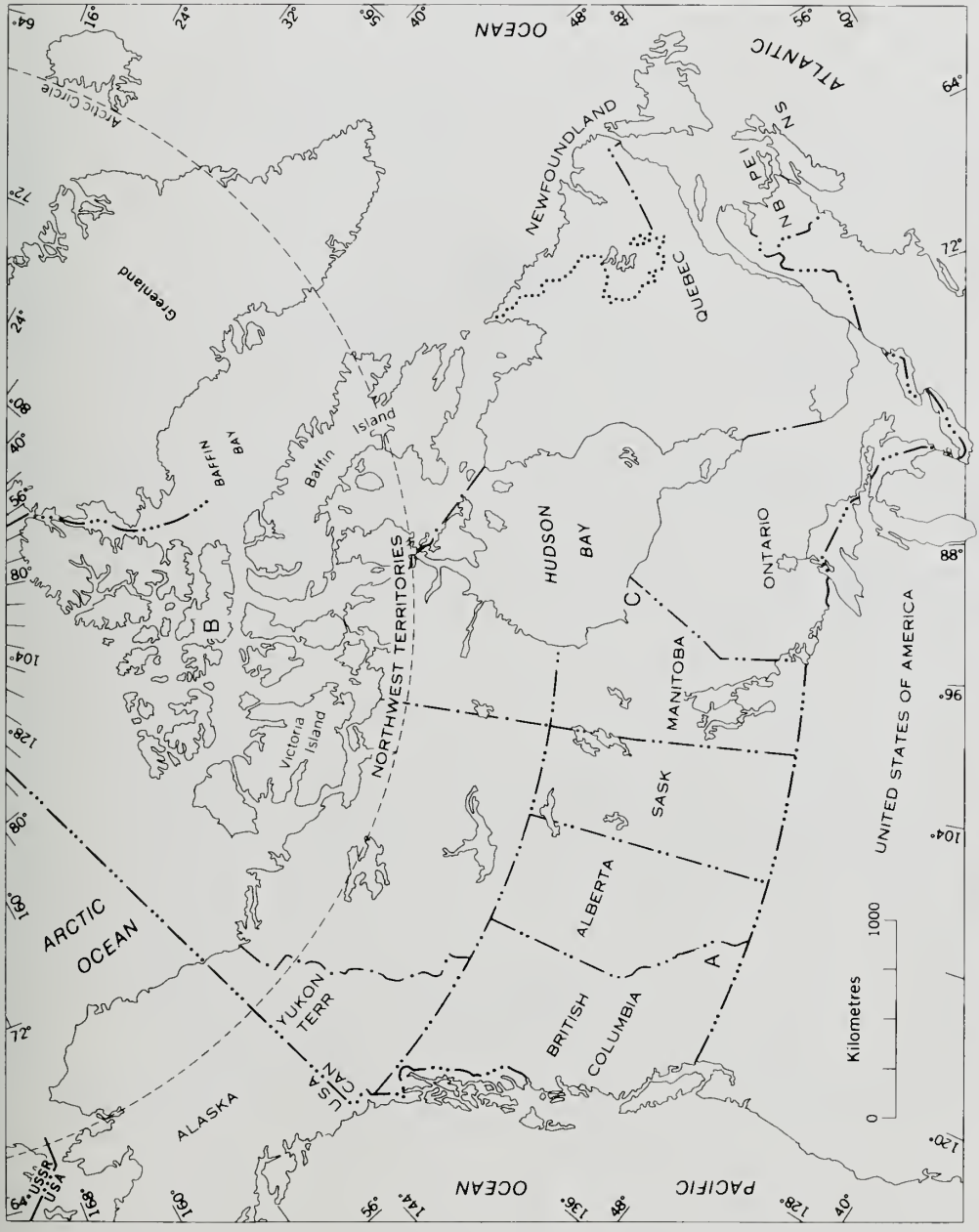

Fig. 1 Locality Map. A, Pedley Pass Section, Rocky Mountains of southeastern British Columbia. B, Snowblind Creek Section, Cornwallis Island, Northwest Territories. C, Sogepet–Aquitaine Kaskattama Province No. 1 Well, Hudson Platform, northeastern Manitoba.

Two sets of nomenclature have been used for an interval of shallow water dolomites between the Churchill River Group (Ashgill) and an unconformity at the base of the Severn River Formation (basal beds high Lower or Middle Llandovery). The Port Nelson Formation (Savage & Van Tuyl 1919; Norford 1971) is based on an outcrop on Nelson River, northern Manitoba; the Red Head Rapids Formation (Nelson 1963, 1964; Sanford 1974; Heywood & Sanford 1976) is based on two outcrops on Churchill River in the same region. The relations are uncertain between these three outcrops and an interval recognized in the subsurface between the Churchill River Group and the Severn River Formation. Nomenclatorial priority suggests the use of the term Port Nelson Formation. The interval reaches 35 m in the subsurface of northern Manitoba and is more than 60 m thick on Southampton Island, where some additional younger strata may be present beneath the sub-Severn River unconformity.

The Silurian Severn River Formation rests on 32 m of the Port Nelson Formation in the Kaskattama well (Norford 1970). The contact is apparently conformable in the well but elsewhere there is evidence of an erosion surface beneath the Severn River Formation. The lower part of the Severn River Formation can be dated as late Early or Middle Llandovery, primarily on the presence of *Virgiana decussata* (Whiteaves). In the well, the Port Nelson Formation consists of dolomites and dolomitic limestones with mudstone partings and nodules, isolated crystals and thin beds of anhydrite and locally halite. In the Kaskattama well, corals and brachiopods in the basal 11 m indicate a very late Ashgill age and correlation with the lower

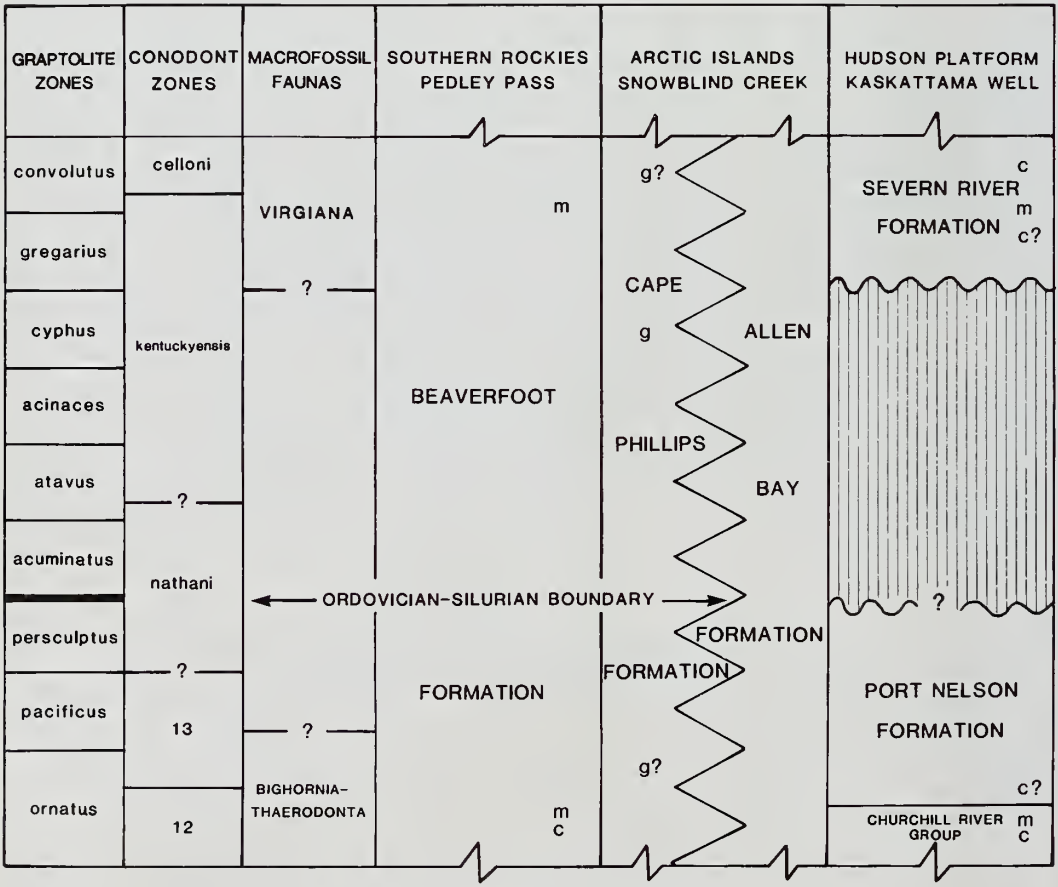

Fig. 2 Correlation diagram of the three areas.

and middle part of the Stonewall Formation of southern Manitoba. The upper 21 m contains only fragmentary fossils in the well, but sparse conodonts (Conodont Alteration Index 1 to 1·5) have been recovered from outcrop 5·5 m below the top of the Port Nelson Formation in its type section. T. T. Uyeno has identified *Panderodus* cf. *P. simplex* Branson & Mehl s.f. and tentatively dates the horizon as early Llandovery, but comments that the form shows some transitional features to those of the Middle and Upper Ordovician form-species *Panderodus compressus* Branson & Mehl.

Thus, in the Hudson Platform the Ordovician–Silurian Boundary lies either within the Port Nelson Formation or within a regional unconformity below the Severn River Formation. The sediments that formed the Port Nelson Formation were inhospitable to animal life, and although one can hope for more refined dating of the upper beds and thus more precise positioning of the Boundary, the region is not suitable for a stratotype of more than local application.

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